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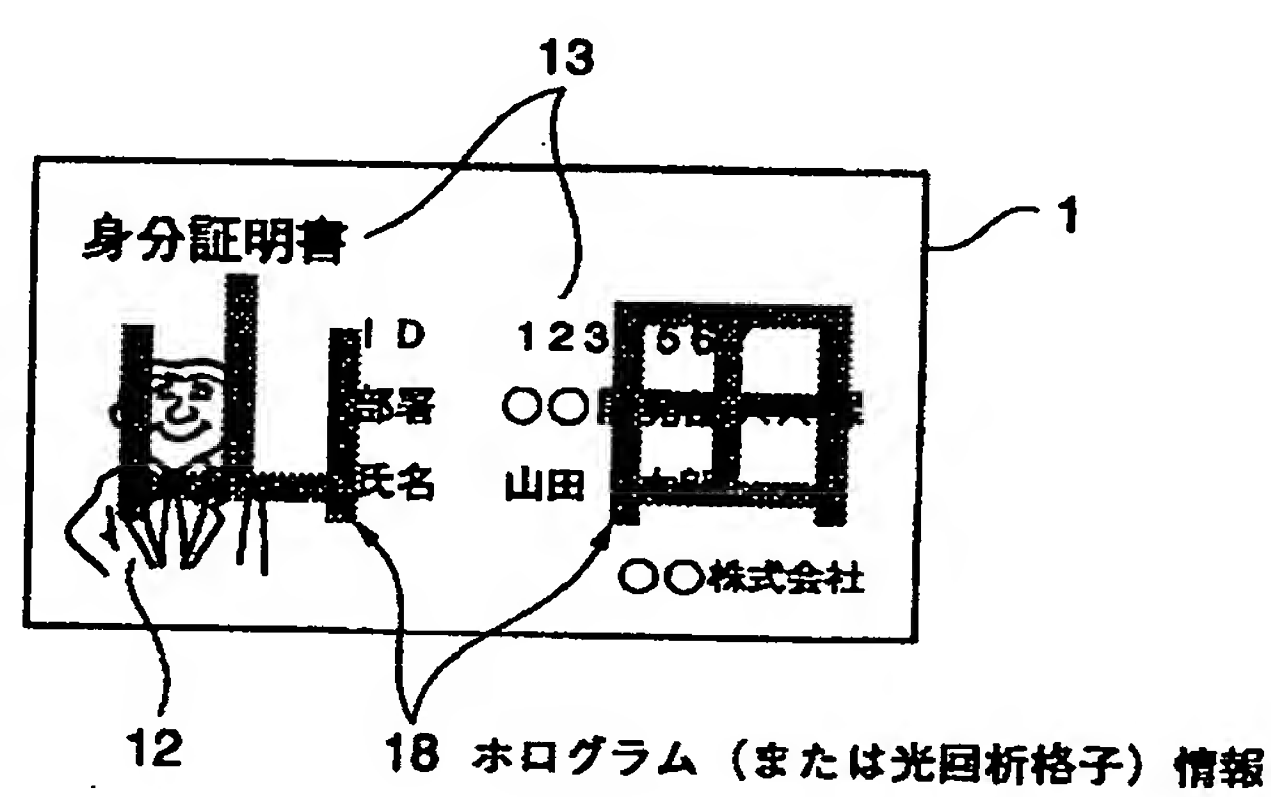
(54)【発明の名称】　IDカードおよびその製造方法

(57)【要約】
【課題】　名字等の個人を特定する文字パターンが透明ホログラムや透明光回折格子によりカード上に形成され、名札としても使用することができるIDカードとその製造方法を提供する。
【解決手段】　本発明のIDカードは、名札としても使用することができ、個人の属性情報12，13が記録されたIDカード上に当該個人を特定する文字パターン18が透明ホログラム層または透明光回折格子層により形作られて形成されていることを特長とする。また、このようなIDカードは、カード基材上に熱転写シートを使用して個人の属性情報12，13を熱転写方式により記録する工程と、当該記録後のカード基材上に個人を特定する文字情報18を透明ホログラムまたは透明光回折格子熱転写シートまたは熱転写ラベルを使用してパターン状に転写または型押しして形成することにより製造することができる。



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KOKAI (Japanese Unexamined Patent Publication) No. 2000-272276

Publication Date: October 3, 2000

Title of the Invention: ID Card and Method of producing the Same

Patent Application No.: 11-80748

Filing Date: March 25, 1999

Applicant: DAINIPPON INK & CHEMICALS Co., Ltd.

Inventor: Satoshi EMOTO

[ABSTRACT]

[OBJECT] To provide an ID card that bears a pattern of characters such as first name identifying an individual person formed thereon in the form of transparent hologram or optical diffraction grating and can also be used as a name plate, and a method of producing the same.

[MEANS FOR SOLVING PROBLEMS]

The ID card according to the present invention, that can also be used as a name plate, is a card having personal attribute information 12, 13 recorded thereon and a character pattern 18 identifying the individual formed thereon in a transparent hologram layer or an optical diffraction grating layer. Such an ID card can be produced through the step of recording the personal attribute information 12, 13 by a thermal transfer method onto a card substrate using a thermal transfer sheet, and the step of forming the pattern of character information 18, that identifies the individual, on the recorded card substrate by transfer or

embossing in the form of transparent hologram or optical diffraction grating using a thermal transfer sheet or label.

[SCOPE OF CLAIM FOR PATENT]

[Claim 1]

An ID card that can also be used as a name plate and bears a pattern of characters such as name identifying an individual person formed thereon in transparent hologram layer or an optical diffraction grating layer formed on the ID card whereon individual attribute information is recorded.

[Claim 2]

The ID card according to claim 1, which comprises a hologram layer or an optical diffraction grating layer that reflects incident light entering at an angle from 45° to 80° from the normal line of the ID card surface with a reflection angle in a range from -10° to 30°.

[Claim 3]

The ID card according to claim 1 or 2, wherein the personal attribute information comprises a photograph of a face printed by a sublimation type thermal transfer method and character information printed by a hot-melt type thermal transfer method.

[Claim 4] The ID card according to claim 1 or 2, wherein the character pattern identifying the individual shows the first or last name of the card holder.

[Claim 5]

A method of producing an ID card, which comprises the steps of recording the personal attribute information by a thermal transfer method onto a card substrate using a thermal transfer

sheet, and forming the pattern of characters identifying the individual on the recorded card substrate in the form of a transparent hologram or a transparent optical diffraction grating, or by transferring a thermal transfer label of the pattern by means of a thermal head.

[Claim 6]

A method of producing an ID card, which comprises the steps of recording the personal attribute information by a thermal transfer method onto a card substrate using a thermal transfer sheet, and forming the pattern of characters identifying the individual on the recorded card substrate in the form of a transparent hologram or a transparent optical diffraction grating, or by embossing to transfer a thermal transfer label of the pattern.

[Claim 7]

The method of producing an ID card according to claim 5 or claim 6, wherein the personal attribute information comprises a photograph of a face printed by a sublimation type thermal transfer method and character information printed by a hot-melt type thermal transfer method.

[DETAILED DESCRIPTION OF THE INVENTION]

[0001]

[Technical Field to which the Invention pertains]

The present invention relates to an ID card that can also

be used as a name plate, wherein the name of the card holder is printed so as to be clearly seen in case the ID card having the personal information recorded thereon is used as a name plate.

[0002]

[Prior Art]

It has been in practice to put an identification card in a name plate case so as to allow use of the card as a name plate as well, although there has been a problem that there is a limitation in the size of the characters and this makes it difficult to read the characters from a distance for identification.

[0003]

Japanese Unexamined Patent Publication (Kokai) No. 4-338593 discloses a technology of laminating a transparent protective layer having undulating surface on a picture forming surface of a substrate whereon a picture is printed by a thermal transfer method in a recording medium such as identification card, thereby to prevent forgery or falsification. However, the technology disclosed in this patent publication makes it indispensable to apply lamination on the picture forming surface in order to prevent forgery or falsification. According to the present invention, in contrast, in order to improve the visibility of the characters such as the name printed for the use as a name plate, the hologram layer or the optical diffraction grating layer is formed as a character pattern regardless of the

picture position. Therefore, the present invention is different from the technology disclosed in the publication mentioned above in that the shape is different from card to card since the hologram (or optical diffraction grating) layer formed as a character pattern is an enlargement of the name or the like formed on the ID card in the present invention.

[0004]

[Problems to be Solved by the Invention]

In the prior art, ID cards having picture and character information printed thereon by a sublimation transfer method or the like have a hologram (or optical diffraction grating) layer as a protective layer in order to prevent falsification of the picture or character information, but lack the features concerning the undulated transparent protective layer formed over the picture forming surface and the configuration and usage of the hologram layer. The present invention, in contrast, provides hologram (or optical diffraction grating) layers representing different names on different ID cards, in order to ensure clear visibility of the name or the like in case the ID cards having various information are used as name plates. The present invention is also characterized in that the transparent hologram (or optical diffraction grating) layer is designed to show the name or the like being enlarged with the highest visibility when viewed squarely in front, in case the ID card is put on the chest of the card holder as a name plate.

[0005]

[Means for Solving the Problems]

In order to achieve the objects described above, a first aspect of the present invention provides an ID card that can also be used as a name plate and bears a pattern of characters such as name identifying an individual person formed thereon in transparent hologram layer or an optical diffraction grating layer formed on the ID card whereon individual attribute information is recorded. As such, the ID card shows the card holder's name or the like with good visibility.

[0006]

In order to achieve the objects described above, a second aspect of the present invention provides a method of producing the ID card, which comprises the steps of recording the personal attribute information by a thermal transfer method onto a card substrate using a thermal transfer sheet, and forming the pattern of characters identifying the individual on the recorded card substrate by thermal transfer in the form of a transparent hologram layer or an optical diffraction grating layer through transfer of a thermal transfer sheet by means of a thermal head. As such, the method of producing the ID card is capable of easily producing the ID card that can also be used as a name plate.

[0007]

In order to achieve the objects described above, a third aspect of the present invention provides a method of producing

the ID card, which comprises the steps of recording the personal attribute information by a thermal transfer method onto a card substrate using a thermal transfer sheet, and forming the pattern of characters identifying the individual on the recorded card substrate by embossing a thermal transfer label in the form of a transparent hologram or an optical diffraction grating using a thermal transfer sheet. As such, the method of producing the ID card is capable of easily producing the ID card that can also be used as a name plate.

[0008]

[MODE FOR CARRYING OUT THE INVENTION]

FIG. 1 is a sectional view of the ID card according to an embodiment of the present invention. Printed by a sublimation transfer method on the surface of a card substrate 11 of the ID card 1 are personal attribute information in the form of sublimation type thermal transfer information 12 and melt type thermal transfer information 13, with a transparent protective layer 14 formed thereon. Formed on the transparent protective layer 14 are a transparent hologram (or optical diffraction grating) layer 15a having a pattern of characters and a transparent reflective thin film layer 15b transferred via a heat sealer layer 16 by means of a thermal head with a transparent protective layer 17 being formed as a topmost layer. The pattern of characters is formed large enough to be read from a distance. For example, a name consisting of three Chinese characters can

be printed on the ID card having sizes in conformity with the JIS standard with each character measuring 20 mm in height and width, so as to be recognized even from a distance of 10 meters. Sublimation type thermal transfer information is used to record images such as the photograph of a face for the excellent gray scale representation, and melt type thermal transfer information is used to record personal attribute information in the form of characters for the capability of high-density recording.

[0009]

FIG. 2 is a sectional view of the ID card according to another embodiment of the present invention. Printed by a sublimation transfer method on the surface of the card substrate 11 of the ID card 1 are personal attribute information in the form of sublimation type thermal transfer information 12 and melt type thermal transfer information 13 by a sublimation transfer method, with a transparent protective layer 14 formed thereon. Formed on the transparent protective layer 14 are the transparent hologram (or optical diffraction grating) layer 15a having a pattern of characters, a transparent reflective thin film layer 15b, an adhesive layer 15c and a transparent label material 15d. In the embodiment shown in FIG. 2, the adhesive layer 15c through the transparent label material 15d including the transparent hologram (or optical diffraction grating) layer 15a and the transparent reflective thin film layer 15b are laminated on the ID card by means of the adhesive layer 15c with a transparent

hologram label 15 transferred therein. While the ID card of the embodiment shown in FIG. 1 is produced by thermal transfer of a pattern of characters from a thermal transfer sheet of transparent hologram or optical diffraction grating by means of a thermal head or the like, the ID card of the embodiment shown in FIG. 2 is produced by transferring a pattern of characters from a thermal transfer label of transparent hologram or optical diffraction grating by embossing.

[0010]

The ID card 1 of the present invention is characterized in that a pattern of characters such as the name that identifies the individual who holds the ID card is transferred onto the transparent hologram (or optical diffraction grating) layer 15a, so as to reflect the incident light within such a predetermined range of view angles that allows a person facing squarely in front of the ID card to easily read the name. In this specification, the word reflection refers to diffracted light, not the reflected light in the ordinary sense.

[0011]

FIG. 3 and FIG. 4 show the ID card in plan view, FIG. 3 showing a case when the ID card is viewed in an angle out of the predetermined range of view angles and FIG. 4 showing a case when the ID card is viewed within the predetermined range of view angles. When viewed in an angle out of the predetermined range, the ID card looks the same as an ordinary identification card. When

viewed within the predetermined range of view angles, the personal attribute information 12, 13 can be read clearly since the information 18 in the form of transparent hologram or the like vanishes. In this case, the ID card is not much useful as a name plate since the name of the melt type thermal transfer information 13 is displayed in small characters. In case the ID card is viewed by a person in the predetermined range of view angles from a position facing squarely as shown in FIG. 4, the hologram (or optical diffraction grating) information 18 showing the Chinese characters reading "Yamada" recorded in an enlarged pattern of characters in the transparent hologram layer can be seen, thus enabling a person located several meters away to read the characters.

[0012]

FIG. 5 shows the front view of the ID card, FIG. 5(A) showing a case when the ID card is viewed as a name plate and FIG. 5(B) showing a case when the ID card is used to read the attribute information. When the ID card is viewed as a name plate as shown in FIG. 5(A), the incident light enters predominantly from above, with the incident angles α in a range from 45° to 80°. In this case, reflection angle β is preferably in a range from -10° to +30° so as to be recognized by human eyes. Assuming that the vertical direction in FIG. 5(A) is the same as the vertical direction of the ID card as worn on the chest of the card holder as a name plate, then light incident on the ID card at incident

angles in the predetermined range α described above from illumination installed on the ceiling is preferably reflected at such angles as enter the eyes of a person facing it squarely at a distance of several meters in front in a range from 10° below to 30° above the normal line H of the ID card surface. The hologram (or diffraction grate) layer is designed so as to satisfy this condition. In case the ID card is used to check the attribute information as shown in FIG. 5(B), the ID card is often held in hand while being tilted at an angle of 45°. Therefore, the attribute information of the ID card can be easily read when illuminated with light at incident angles α in a range from 0° to 45° and the light is not reflected with angle β in a range from 0° to -45°.

[0013]

In the case of optical diffraction grating, average pitch of undulation on the layer surface taken as the lattice constant d, wavelength λ, incident angle α, and diffraction angle (or reflection angle) β satisfy the following relationship (1) in a bright portion of diffraction pattern.

$d(\sin\alpha - \sin\beta) = m\lambda$ (1)

When m = 1 and the incident angle $\alpha = 45°$, in order to have green light ($\lambda = 550 \times 10^{-9}$ m) that most effectively stimulates the visual sense diffracted at a diffraction angle of $\beta = 0°$, d_1 must be 777.9 nm. Similarly, d_2 = 635.1 nm when the incident angle $\alpha = 60°$ and diffraction angle of green light $\beta = 0°$.

[0014]

Wavelengths of visible light are from 400 nm to 700 nm. Thus in case the diffraction grating has a pitch of 550 nm, it is desirable that diffraction angles β are in a range from $-10°$ to $30°$ when incident angles α are from $45°$ to $80°$ and diffraction angles β are in a range from $-45°$ to $0°$ when incident angles α are from $0°$ to $45°$. Through calculations as described above made for grating pitches ranging from 550 nm to 750 nm and wavelengths ranging from 550 nm to 700 nm, it has been verified that the above-mentioned conditions are substantially satisfied, in particular for wavelengths shorter than green light of first order diffraction. In order to further improve the visibility of the card used as a name plate when viewed from a distance, a diffraction grating that has higher diffraction efficiency may be used, such as blazed diffraction grating or volume hologram.

[0015]

Now components of the ID card according to the present invention will be described below, A: card substrate, B: sublimation type thermal transfer information, C: melt type thermal transfer information, D: transparent protective layer, E: transparent hologram (optical diffraction grating) layer and F: transparent reflective thin film layer.

[0016] A. Card substrate

For the material to make the card substrate, there is no limitation to the kind of material as long as the material has

a sufficient mechanical strength such as rigidity for the application to the ID card, allowing the ID card to be used while encased in a name plate case, and at least sublimation type thermal transfer information and melt type thermal transfer information can both be formed when producing the ID card. A plurality of sheets of the same kind or different kinds may also be laminated to form the substrate, in order to increase the mechanical strength. Moreover, a substrate having information that is common to cards of the same type printed on a visible layer may also be used. For the purpose of preventing forgery or falsification of the ID card, such a substrate may also be used that is subjected to special processing for forgery prevention which can be verified by separate means such as transparent fluorescent printing or the like.

[0017]

The ID card used in the present invention must be made of an ordinary plastic card that complies to the JIS standard. Common constitution of the ID card is a white-colored hard vinyl chloride sheet 0.56 mm thick (may also be two sheets 0.28 mm thick that are laminated together) sandwiched by two white-colored hard vinyl chloride sheets 0.1 mm thick fused on both sides thereof so as to form a sheet having thickness of 0.76 mm, that is cut into individual cards each measuring 54.0 mm long and 85.6 mm wide. The ID card may also have a magnetic stripe fused thereon or an IC chip embedded therein, as required. A silk panel or a sign

panel may also be provided to allow writing thereon or, alternatively, a label or the like made separately may be adhered thereon.

[0018]

As the substrate 11 of the card suitable for recording sublimation type thermal transfer information, such plastic materials as polyethylene terephthalate, polyester, polypropylene, polystyrene, polysulfone, polyphenylene sulfide, polyethylene naphthalate, alamide, polycarbonate and polyvinyl alcohol may be used, among which polyester sheet (PET) such as polyethylene terephthalate is most preferably used. A substrate having a receiving layer for sublimable transfer dye may also be used in order to accommodate both sublimation type thermal transfer information and melt type thermal transfer information, depending on the kind of substrate material. Since there are little options for the surface whereon the melt type thermal transfer information is recorded, it is practiced to cover a substrate material that is not suitable for applying a sublimable transfer dye, such as a vinyl chloride sheet, partially with a receiving layer for sublimable transfer dye, and record the melt type thermal transfer information on the vinyl chloride sheet and record the sublimation type thermal transfer information on the receiving layer.

[0019]

Embossing, sign panel, optical recording layer, magnetic

recording layer or other printing may also be provided, or an IC chip or an antenna coil may be embedded on the side of the card substrate opposite to the transparent hologram (or optical diffraction grating) layer. These may be provided during one of the processes of producing the ID card of the present invention, or after producing.

[0020] B. Sublimation type thermal transfer information

Sublimation type thermal transfer information refers to information that has monochrome or multi-color gray scale formed by means of a sublimable dye. ID cards for corporate employees or college students often have photographs of face printed thereon in the form of sublimation type thermal transfer information. The sublimation type thermal transfer information is formed on the substrate surface of the ID card or on a receiving layer provided on the substrate surface of the ID card by a picture forming method using a sublimation thermal transfer sheet that will be described below.

[0021]

FIG. 6 is a sectional view showing an embodiment of thermal transfer sheet used in thermal transfer of information. The thermal transfer sheet 2 shown in FIG. 6 is a thermal transfer ribbon comprising a film 21 having sublimable dye ink layers (three colors of yellow, magenta and cyan) 28 and a hot-melt ink layer (for example, black) region 22 formed thereon in a face serial manner. That is, sublimable dye ink layers made of a

binder including sublimable dyes, for example a yellow sublimable ink layer 28 (Y), a magenta sublimable ink layer 28 (M) and a cyan sublimable ink layer 28 (C), are formed on one surface of the film 21 in a face serial manner, and a hot-melt ink layer 22 is formed adjacent to the sublimable cyan ink layer 28 (C). The thermal transfer sheet of this constitution enables it to form a color image of a photograph of a face, for example, from yellow, magenta and cyan sublimable transfer inks by using one kind of thermal transfer sheet, and print characters and symbols clearly with high density hot-melt ink layer of, for example, black color. Of course, sublimable dye ink layer and hot-melt ink layer may also be used to print different information.

[0022]

The hot-melt ink layer 22 is preferably formed by applying a release layer 22a, a release protective layer 22b and a hot-melt ink layer 22c from the substrate film 21 side in a face serial manner, as shown in FIG. 6. A heat-resistant slip layer 23 that provides heat resistance and slippery surface and releasability is formed on the back surface of the substrate film 21 opposite to the thermal transfer ink layer, in order to prevent fusing with the thermal head, improve heat resistance/slipperiness and prevent the thermal transfer ink layer and the back surface from bonding with each other when the thermal transfer sheet is wound up in a roll. The heat-resistant slip layer 23 is not inevitable but is preferably provided when necessary.

[0023]

All of known materials commonly used in the conventional sublimation dye transfer sheets or hot-melt ink transfer sheets may be used as materials for constituting the layers in the thermal transfer sheet 2. For example, plastic films, such as polyester films including polyethylene terephthalate films, polystyrene films, polypropylene films, polysulfone films, polyphenylene sulfide films, polycarbonate films, and cellulosic resin films; and paper and various types of converted paper may be used as the substrate film 21. Among them, polyester films are preferred, and a polyethylene terephthalate film is more preferred. The thickness of the substrate film is in the range of from about 2 to 50 μm, preferably about 3 to 10 μm. Further, if necessary, a primer layer (not shown) may be preferably provided on one or both surfaces of the substrate film 21 from the viewpoint of improving the adhesion of the substrate film to the thermal transfer ink layer and the heat-resistant slip layer. The above substrate film 21 may be used not only as the substrate film for the above thermal transfer ink sheet but also as the substrate film for the transparent protective layer described below, as the substrate film for a hologram transfer sheet described below, and as a transparent film laminated on the outermost layer of a laminate including a hologram layer.

[0024]

In FIG. 6, the heat-resistant slip layer 23 provided on the

surface of the substrate film 21 remote from the thermal transfer ink layer may be formed of a material having good releasability and heat resistance, for example, a curable silicone oil, a curable silicone wax, a silicone resin, a fluororesin, or an acrylic resin. The heat-resistant slip layer may also be formed of a material prepared by reacting a thermoplastic resin having -OH or -COOH group with a compound having two or more amino groups or a diisocyanate or a triisocyanate to cure the resin through crosslinking. The slip property can be further improved by incorporating a phosphoric ester surfactant or a filler having cleavability, such as talc or mica, into the heat-resistant slip layer.

[0025]

All the dyes which are melted, diffused, or transferred by sublimation upon heating and used in the conventional thermal transfer film may be effectively used as dyes for the sublimable dye ink layer in the present invention, that is, a sublimable yellow ink layer 28 (Y), a sublimable magenta ink layer 28 (M), and a sublimable cyan ink layer 28 (C). However, the dyes used are preferably selected by taking into consideration hue, light fastness, and solubility in the binder. Examples of such dyes include diarylmethane dyes; triarylmethane dyes; thiazole dyes; methine dyes, such as merocyanine; azomethine dyes, exemplified by indoaniline, acetophenone azomethine, pyrazolone azomethine, imidazole azomethine, imidazo azomethine, and pyridine

azomethine; xanthene dyes; oxazine dyes; cyanomethylene dyes exemplified by dicyanostyrene and tricyanostyrene; thiazine dyes; azine dyes; acridine dyes; benzene azo dyes; azo dyes exemplified by pyridine azo, thiophene azo, isothiazole azo, pyrrole azo, pyrazole azo, imidazole azo, thiadiazole azo, triazole azo, and disazo dyes; spiropyran dyes; indolinospiropyran dyes; fluoran dyes; rhodamine lactam dyes; naphthoquinone dyes; anthraquinone dyes; and quinophthalone dyes.

[0026]

Specific examples of dyes are as follows:

C.I. (Color Index) Disperse Yellow 51, C.I. Disperse Yellow 3, C.I. Disperse Yellow 54, C.I. Disperse Yellow 79, C.I. Disperse Yellow 60, C.I. Disperse Yellow 23, C.I. Disperse Yellow 7 and C.I. Disperse Yellow 141;

C.I. Disperse Blue 24, C.I. Disperse Blue 56, C.I. Disperse Blue 14, C.I. Disperse Blue 301, C.I. Disperse Blue 334, C.I. Disperse Blue 165, C.I. Disperse Blue 19, C.I. Disperse Blue 72, C.I. Disperse Blue 87, C.I. Disperse Blue 287, C.I. Disperse Blue 154, C.I. Disperse Blue 26 and C.I. Disperse Blue 354;

C.I. Disperse Red 135, C.I. Disperse Red 146, C.I. Disperse Red 59, C.I. Disperse Red 1, C.I. Disperse Red 73, C.I. Disperse Red 60 and C.I. Disperse Red 167;

C.I. Disperse Orange 149;

C.I. Disperse Violet 4, C.I. Disperse Violet 13, C.I. Disperse

Violet 26, C.I. Disperse Violet 36, C.I. Disperse Violet 56 and C.I. Disperse Violet 31;

C.I. Disper Yellow 56, C.I. Disper Yellow 14, C.I. Disper Yellow 16, C.I. Disper Yellow 29 and C.I. Disper Yellow 201;

C.I. Solvent Blue 70, C.I. Solvent Blue 35, C.I. Solvent Blue 63, C.I. Solvent Blue 50, C.I. Solvent Blue 49, C.I. Solvent Blue 111, C.I. Solvent Blue 105, C.I. Solvent Blue 97 and C.I. Solvent Blue 11;

C.I. Solvent Red 135, C.I. Solvent Red 81, C.I. Solvent Red 18, C.I. Solvent Red 25, C.I. Solvent Red 19, C.I. Solvent Red 23, C.I. Solvent Red 24, C.I. Solvent Red 143, C.I. Solvent Red 146 and C.I. Solvent Red 182;

C.I. Solvent Violet 13;

C.I. Solvent Black 3; and

C.I. Solvent Green 3.

For example, dyes usable in the present invention are cyan dyes including Kayaset Blue 714 (Solvent Blue 63, manufactured by Nippon Kayaku Co., Ltd.), Foron Brilliant Blue S-R (Disperse Blue 354, manufactured by Sandoz K.K.), and Waxoline AP-FW (Solvent Blue 36, manufactured by ICI Japan); magenta dyes including MS-RED G (Disperse Red 60, manufactured by Mitsui Toatsu Chemicals, Inc.) and Macrolex Violet R (Disperse Violet 26, manufactured by Bayer), and yellow dyes including Foron Brilliant Yellow S-6GL (Disperse Yellow 231, manufactured by Sandoz K.K.) and Macrolex Yellow 6G (Disperse Yellow 201,

manufactured by Bayer).

[0027]

The binder resin for holding the above dye may be any conventional one, and examples of such a binder resin include cellulosic resins, such as ethyl cellulose, ethylhydroxy cellulose, hydroxypropyl cellulose, methyl cellulose, and cellulose acetate, vinyl resins, such as polyvinyl alcohol, polyvinyl acetate, polyvinyl butyral, polyvinyl acetal, and polyvinyl pyrrolidone, acrylic resins, such as poly(meth)acrylate and poly(meth)acrylamide, polyurethane resins, polyamide resins, and polyester resins. These resins may be used alone or as a mixture of two or more. Among the above resins, polyvinyl butyral and polyvinyl acetal are preferred from the viewpoint of dye transfer and storage stability of the thermal transfer film.

[0028]

Further, in the present invention, the following releasable graft copolymer may be used as a binder or as a release agent added to the binder. Alternatively, the releasable graft copolymer may be used in a layer, containing a releasable resin, optionally provided on the outermost layer of the sublimable dye ink layer. The releasable graft copolymer may be prepared by graft-polymerizing at least one releasable segment selected from a polysiloxane segment, a fluorocarbon segment, a fluorohydrocarbon segment, and a long-chain alkyl segment onto

a main chain of a polymer. The graft copolymer prepared by grafting a polysiloxane segment onto a main chain of polyvinyl acetal resin is particularly preferred.

[0029]

When the graft copolymer is used as a release agent for the sublimable dye ink layer, the content of the releasable segment in the release agent is preferably such that the content of the releasable segment in the graft copolymer is in the range of from 10 to 80% by weight. When the content of the releasable segment is excessively low, the releasability is unsatisfactory, while when it is excessively high, the miscibility with the binder is lowered, causing a problem associated with dye transfer or the like. When the above release agents are added to the sublimable dye ink layer, they may be used alone or as a mixture of two or more. The amount of the release agent added is preferably 1 to 40 parts by weight based on 100 parts by weight of the binder resin. When the amount of the release agent added is excessively small, the release effect is unsatisfactory, while when it is excessively large, deterioration in the transfer of the dye from the sublimable dye ink layer or the coating strength and problems of discoloration of the dye contained in the sublimable dye ink layer and storage stability of the thermal transfer film unfavorably occur.

[0030]

The sublimable dye ink layer, i.e., a sublimable yellow ink

layer 28 (Y), a sublimable magenta ink layer 28 (M), and a sublimable cyan ink layer 28 (C), may be preferably formed by coating the above substrate film with a solution of the above dye and binder resin and optionally various additives dissolved in a suitable solvent or a dispersion of the above components in a suitable organic solvent or water by gravure printing, screen printing, or reverse roll coating using a gravure plate in the case of a single color and then drying the resultant coating to form respective sublimable dye ink layers. In this case, each sublimable dye ink layer may be provided by single coating. Alternatively, it may be provided by double coating. The double coating can enhance the dye coverage per unit area, Further, the provision of a layer (not shown) containing the above releasable resin as the outermost layer of the sublimable dye ink layer can prevent heat fusing of the sublimable dye ink layer even when printing is carried out on an image-receiving object lean in a releasable component, such as a plastic card. The thickness of the sublimable dye ink layer thus formed is suitably about 0.2 to 5.0 μm, preferably about 0.4 to 2.0 μm.

[0031] C. Melt type thermal transfer information

The ID card carries, in addition to the sublimation type thermal transfer information described above, ID code, characters representing the personal attribute information such as the name and the organization to which the card holder belongs, symbols, diagram and/or bar code. Such information as characters,

symbols, diagram and bar code is recorded usually with black monochrome medium. In case the ID card is to be processed by a separate system (such as OCR apparatus or bar code reader), in particular, the information must be printed clearly with a dark color and therefore the characters and/or bar code must be printed by a hot-melt type thermal transfer method.

[0032]

In FIG. 6, the release layer 22a as the innermost layer in the hot-melt ink layer region 22 provided adjacent to the sublimable cyan ink layer 28 (C) may be formed of a wax used as a vehicle in the hot-melt ink layer described below, or a releasable resin, such as silicone resin, fluororesin, acrylic resin, cellulosic resin, vinyl chloride/vinyl acetate copolymer resin, polyvinyl alcohol, or urethane resin. They may be used alone or as a mixture of two or more. The release layer 22a may be formed in the same manner as described above in connection with the sublimable dye ink layer, that is, by gravure printing, screen printing or other means, and a thickness of about 0.1 to 5 μm suffices for the release layer 22a.

[0033]

The release protective layer 22b provided on the release layer 22a may be formed of preferably a resin having excellent transparency, abrasion resistance, chemical resistance, and other properties, such as acrylic resin, polyester resin, or urethane resin. It may be formed by preparing a solution of a

suitable resin in the same manner as described above in connection with the formation of the sublimable dye ink layer and coating the solution in a thickness of about 0.2 to 10 μm by the above printing method. In the formation of the release protective layer 22b, it is also possible to add a filler, such as silica or alumina, for the purpose of improving the releasability at the time of transfer. In addition, when the abrasion resistance and the slip property should be improved, a wax, such as polyethylene wax, may be incorporated into the release protective layer 22b. It should be noted that the provision of the release layer 22a may be omitted when the releasability of the release protective layer 22b from the substrate film 21 is satisfactory.

[0034]

The hot-melt ink layer 22c provided on the release protective layer 22b comprises a colorant and a vehicle and optionally suitable additives. The colorant is preferably an organic or an inorganic pigment or dye which has good properties as a recording material, for example, a satisfactory color density and resistance to light, heat, temperature and the like sufficient to prevent fading. Although yellow, magenta, cyan, and the like may be used as the colorant, a black colorant which can provide a print of sharp characters and symbols with high density is preferred from the viewpoint of the object of the present invention.

[0035]

Waxes usable as the vehicle include mixtures of wax, as a main component, and drying oil, a resin, mineral oil, cellulose and a rubber derivative. Examples of the wax include microcrystalline wax, carnauba wax, and paraffin wax. It is also possible to use other various waxes such as Fischer-Tropsh wax, various low-molecular weight polyethylene, Japan wax, beeswax, spermaceti, insect wax, wool wax, shellac wax, candelilla wax, petrolatum, partially modified wax, fatty acid esters, and fatty acid amides. In the present invention, in view of the adhesion and scratch resistance to the card, it is preferred to use, as the vehicle of the black ink layer, a vinyl chloride-vinyl acetate copolymer resin or an acrylic resin, or a resin prepared by mixing the acrylic resin with at least one of chlorinated rubber, vinyl chloride-vinyl acetate copolymer resin and cellulose resin.

[0036]

The hot-melt ink layer 22c may be formed on the release protective layer 22b provided on the substrate film 21 by coating in a pattern form according to, for example, a hot-melt coating method using a gravure plate or other conventional coating methods such as hot lacquer coating, or gravure coating. In the case of full solid coating, in addition to the above coating methods, gravure reverse coating, roll coating and the like may be used. The thickness of the hot-melt ink layer should be determined by taking into consideration the balance of necessary density and heat sensitivity. In general, it is preferably in the

range of from 0.2 to 10 μm.

[0037] D. Transparent protective layer

The ID card is provided with a transparent protective layer 14 to cover the sublimation type thermal transfer information (photograph of face, etc.) and the melt type thermal transfer information (ID code, name, etc.), for the purpose of improving the forgery prevention and durability performance. When forming the transparent protective layer, a transfer sheet is usually used. This sheet, the peel-off layer, the transparent protective layer and, if necessary, a bonding layer are stacked on a support structure in a face serial manner. The transparent protective layer may be formed on the same surface of the same substrate film as the sublimation thermal transfer sheet and the fusing thermal transfer sheet. The transparent protective layer 14 may be formed from a transparent resin such as polyester, acrylic resin, urethane resin or copolymer of vinyl chloride - vinyl acetate, or a mixture of these resins.

[0038] E. Transparent hologram (or optical diffraction grating) layer

The transparent hologram (or optical diffraction grating) layer 15a in the present invention is intended not only to provide forgery preventing function and protective function, but also to display the pattern of name or the like as hologram (or optical diffraction grating) information that can be seen with a high brightness when viewed within the predetermined view angles (or

a particular view angle therein), so as to function as a name plate. Since the transparent hologram (or optical diffraction grating) layer does not reflect light and becomes transparent at particular angles that are out of a specific region, information recorded on the ID card can be read sufficiently and the functions of the ID card will not be compromised.

[0039]

The transparent hologram (or optical diffraction grating) layer is formed in a pattern of characters by a thermal transfer sheet for hologram or a label on the sublimation type thermal transfer information region, melt type thermal transfer information region, the transparent protective layer of the ID card. For the hologram sheet, a relief type hologram sheet, a relief type diffraction grating sheet or a Lippmann (phase volume) type hologram sheet may be used. The relief type hologram sheet is made by forming a hologram layer and a hologram effect layer in a face serial manner on a support film. Specifically, hologram is formed on a resin layer that is a solid at normal temperatures and has thermoplasticity, such as UV-curing resin provided on the surface of a support material such as PET film. A master hologram plate with the surface embossed in a hologram interference (or optical diffraction grating) pattern is pressed against the surface so as to transfer the embossed pattern onto the resin layer surface that is then cured, followed by the formation of the thin hologram effect layer, that is made of a

material having sufficient transparency and a coefficient of refraction different from that of the hologram layer, such as vapor deposition film of zinc sulfide or titanium oxide, on the embossed surface.

[0040]

FIG. 7 is a sectional view showing an embodiment of the thermal transfer sheet for hologram used to transfer the hologram layer. The thermal transfer sheet comprises a substrate film 31 with a heat-resistant slip layer 33 provided on one surface thereof as required, while a release protective layer 32b, a transparent hologram (or optical diffraction grating) layer 36, a transparent reflective thin film layer 37 and a heat sealer layer 38 are formed in a face serial manner on the other surface. Primer layers (not shown) may be provided between these layers in case the layers are not sufficiently adhesive. In FIG. 7, the substrate film 31 and the heat-resistant slip layer 33 can be made of the same material as that of the thermal transfer sheet used in forming the image shown in FIG. 6, of which description has been given and will not be repeated here.

[0041]

The release protective layer 32b has suitable releasability from the substrate film 31 and, after the transfer, serves to protect the hologram layer 36. When a biaxially stretched polyethylene terephthalate film is used as the substrate film 31, the release protective layer 32b may be

preferably formed of, for example, a cellulose acetate resin containing a minor amount of a melamine resin with a methylol group introduced thereinto. It may be provided by coating a solution of such a resin and drying the coating. In addition, an acrylic resin, a urethane resin, an acrylic urethane resin, a polyester resin, a vinyl chloride/vinyl acetate copolymer resin, or a mixture of the above resins, which is generally known as a protective layer forming resin, may be suitably used depending upon the substrate film used. It is also possible to use an ionizing radiation-curing resin having excellent plasticizer resistance. Further, the incorporation of a wax, a lubricant, an antioxidant, or a fluorescent brightening agent as an additive into the above resin can improve the slip property, light fastness, weather resistance, whiteness, and other properties of image faces to be covered.

[0042]

The transparent hologram (or optical diffraction grating) layer 36 provided on the release protective layer 32b is generally formed of a resin. This layer per se may have either a single layer structure or a multi-layer structure. Further, the hologram layer 36 may be of a plane type hologram or a volume type hologram. In the case of a plane type hologram, a relief hologram is particularly preferred from the viewpoint of mass productivity and cost. In addition, laser reproduction holograms, such as a Fresnel hologram, a Fraunhofer hologram, a lensless Fourier

transform hologram, and an image hologram, and white light reproduction holograms, such as a rainbow hologram, and holograms utilizing these principles, such as a color hologram, a computer hologram, a hologram display, a multiplex hologram, a holographic stereogram, a holographic diffraction grating and the like may be used.

[0043]

It is possible to use, in addition to the hologram and diffraction grating thus printed, directly formed diffraction grating and CGH (computer generated hologram) like EB drawing apparatus and ruling engine. Since the ID card bears a pattern of characters formed thereon in the form of transparent hologram or diffraction grating, any stereoscopic image is not formed and the formed pattern is easily recognized. Therefore, diffraction grating is preferable. The hologram is preferably an image hologram wherein the regenerated image is regenerated in the vicinity of the recorded surface, and more preferably a hologram wherein a plane image, for example, plane such as scatter plate and a light scattering element are printed.

[0044]

Hologram forming photosensitive materials usable for recording an interference fringe include silver salts, gelatin dichromate, thermoplastics, diazo photosensitive material photoresists, ferroelectrics, photochromic materials, and chalcogen glass. Materials for a hologram layer include

thermoplastic resins, such as polyvinyl chloride, acrylic resins (e.g., polymethyl methacrylate), polystyrene, and polycarbonate, and cured products of thermosetting resins, such as unsaturated polyesters, melamine, epoxy, polyester (meth)acrylate, urethane (meth)acrylate, epoxy (meth)acrylate, polyether (meth)acrylate, polyol (meth)acrylate, melamine (meth)acrylate, and triazine acrylate, and mixtures of thermoplastic resins with thermosetting resins.

[0045]

Additional materials usable for the transparent hologram (or optical diffraction grating) layer 36 are thermoformable materials having a free-radical polymerizable unsaturated group which are classified into the following two types.

[I] Polymers, having a glass transition point of 0 to 250°C, having a free-radical polymerizable unsaturated group. More specifically, polymers prepared by introducing a free-radical polymerizable unsaturated group into homopolymers or copolymers of the following compounds (by any one of methods (i) to (iv) described below may be used.

(1) Monomers having a hydroxyl group, for example, N-methylolacrylamide, 2-hydroxyethyl (meth)acrylate, 2-hydroxypropyl (meth)acrylate, 2-hydroxybutyl (meth)acrylate, and 2-hydroxy-3-phenoxypropyl (meth)acrylate.

(2) Monomers having a carboxyl group, for example, acrylic acid, methacrylic acid, and acryloyloxyethyl monosuccinate.

(3) Monomers having an epoxy group, for example, glycidyl methacrylate.

(4) Mohomers having an aziridinyl group, for example, 2-aziridinylethyl methacrylate and allyl 2-aziridinylpropionate.

(5) Monomers having an amino group, for example, acrylamide, methacrylamide, diacetonacrylamide, dimethylaminoethyl methacrylate, and diethylaminoethyl methacrylate.

(6) Monomers having a sulfone group, for example, 2-acrylamido-2-methylpropanesulfonic acid.

(7) Monomers having an isocyanate group, for example, an adduct of a diisocyanate and a free-radical polymerizable monomer having an active hydrogen, such as a 1:1 (molar ratio) adduct of 2,4-toluene diisocyanate and 2-hydroxyethyl acrylate.

(8) Further, the above compounds may be copolymerized with the following monomers copolymerizable with the above compounds in order to regulate the glass transition point of the above homo- or copolymers or to regulate properties of cured films. Such copolymerizable monomers include, for example, methyl (meth)acrylate, ethyl (meth)acrylate, propyl (meth)acrylate, butyl (meth)acrylate, isobutyl (meth)acrylate, t-butyl (meth)acrylate, isoamyl (meth)acrylate, cyclohexyl (meth)acrylate, and 2-ethylhexyl (meth)acrylate.

[0046] The polymer thus prepared is then reacted by any one of the methods (i) to (iv) to introduce a free-radical polymerizable unsaturated group thereinto to prepare a hologram forming resin.

(i) In the case of a homo- or copolymer of a monomer having a hydroxyl group, the polymer is condensed with a monomer having a carboxyl group, such as acrylic acid or methacrylic acid.

(ii) In the case of a homo- or copolymer of a monomer having a carboxyl or sulfone group, the polymer is condensed with the above monomer having a hydroxyl group.

(iii) In the case of a homo- or copolymer of a monomer having an epoxy, isocyanate, or aziridinyl group, the polymer is subjected to an addition reaction with the above monomer having a hydroxyl group or the monomer having a carboxyl group.

(iv) In the case of a homo- or copolymer of a monomer having a hydroxyl or carboxyl group, the polymer is subjected to an addition reaction with a monomer having an epoxy group, a monomer having an aziridinyl group, or a 1:1 (molar ratio) adduct of a diisocyanate compound and a hydroxyl-containing acrylic ester monomer.

[0047]

Preferably, the above reaction is carried out in the presence of a very small amount of a polymerization inhibitor, such as hydroquinone, while introducing dry air.

[2] Compounds, having a melting point of 0 to 250°C, having a free-radical polymerizable unsaturated group. Specifically, stearyl (meth)acrylate, triacryl isocyanurate, cyclohexanediol di(meth)acrylate, spiroglycol di(meth)acrylate and the like may be used. Further, a mixture of the compounds [1] and [2] may also

be used, and it is also possible to add a free-radical polymerizable unsaturated monomer thereto. The free-radical polymerizable unsaturated monomer functions to improve the crosslinking density and the heat resistance upon ionizing radiation irradiation. In addition to the above monomers, ethylene glycol di(meth)acrylate, polyethylene glycol di(meth)acrylate, hexanediol di(meth)acrylate, trimethylolpropane tri(meth)acrylate, trimethylolpropane di(meth)acrylate, pentaerythritol tetra(meth) acrylate, pentaerythritol tri (meth)acrylate, dipentaerythritol hexa(meth)acrylate, ethylene glycol diglycidyl ether di(meth)acrylate, polyethylene glycol diglycidyl ether di(meth)acrylate, propylene glycol diglycidyl ether di(meth)acrylate, polypropylene glycol diglycidyl ether di(meth)acrylate, and sorbitol tetraglycidyl ether tetra(meth)acrylate may be used as the free-radical polymerizable unsaturated monomer. The free-radical polymerizable unsaturated monomer may be used in an amount of 0.1 to 100 parts by weight based on 100 parts by weight on a solid basis of the above copolymer mixture. Curing may be satisfactorily achieved by using an electron beam. In the case of curing by ultraviolet light irradiation, it is also possible to use, as a sensitizer, benzoquinone, benzoin, and a benzoin ether, such as benzoin methyl ether, a halogenated acetophenone, or a biacetyl which can generate a free radical upon being exposed

to ultraviolet light.

[0048]

The transparent hologram (or optical diffraction grating) layer 36 may be formed by the conventional method. For example, when a transparent hologram is a relief hologram, a hologram layer having a relief forming face may be formed by providing, as a press mold, an original plate, for a hologram, with an interference fringe recorded in a relief form, placing a hologram forming resin sheet on the original plate for a hologram, heat-pressing the original plate for a hologram against the hologram forming resin sheet by means of a heating roll or the like to replicate the relief pattern, provided on the original plate for a hologram, on the surface of the hologram forming resin sheet, thereby preparing a transparent hologram (or optical diffraction grating) layer 36 having a surface with a relief formed thereon.

[0049] F. transparent reflective thin film layer

An embodiment wherein a transparent reflective thin-film layer 37 is provided on the transparent hologram (or optical diffraction grating) layer 36 is not limited to a relief hologram and applicable also to other holograms. The transparent reflective thin-film layer 37 may be formed of any material which can develop a hologram effect and, at the same time, does not mask the underlying image layer or the like, for example, a transparent material having a refractive index different from the hologram (or optical diffraction grating) layer 36, or a reflective

thin-film layer, of a metal, having a thickness of not more than 200 Å. In the former material, the refractive index may be larger or smaller than that of the hologram (or optical diffraction grating) layer 36. In this case, the difference in refractive index between the reflective thin-film layer and the hologram layer is preferably not less than 0.1, more preferably not less than 0.5. The provision of a transparent thin-film layer having a different refractive index can develop a hologram effect and does not mask the underlying image layer. In the case of the latter material, i.e., a reflective thin-film layer of a metal, since the thickness is not more than 200 Å, the transmittance of a light wave is so large that the thin-film layer can develop a hologram effect by virtue of partial reflection and, at the same time, permits transmission of light, i.e., does not mask the underlying image layer.

[0050]

For example, the following materials (1) to (6) may be used for constituting the transparent reflective thin-film layer 37.

(1) Transparent thin-film layer having a larger refractive index than the hologram (or optical diffraction grating) layer:

Transparent thin-film layers of this type are classified into those which are transparent in a visible region and those which are transparent in an infrared or ultraviolet region. Representative examples thereof are as follows. The refractive index (n) of the material is given in parentheses [The same is

applied to the materials (2) to (5)]. Materials which are transparent in a visible region include Sb_2S_5 (3.0), Fe_2O_3 (2.7), PbO (2.6), ZnSe (2.6), CdS (2.6), Bi_2O_3 (2.4), TiO_2 (2.3), $PbCl_2$ (2.3), Zns (2.1), ZnO (2.1), CdO (2.1), SiO (2.0), and TiO (1.9). Materials which are transparent in an infrared or ultraviolet region include CdSe (3.5), CdTe (2.6), Ge (4.0 - 4.4), PbTe (5.6), Si (3.4), Te (4.9), TlCl (2.9), and ZnTe (2.8).

[0051] (2) Transparent ferroelectric substances having a higher refractive index than the hologram (or optical diffraction grating) layer: Specific examples of transparent ferroelectric substances of this type include CuCl (2.0), CuBr (2.2), GaP (3.3 to 3.5), KH_2AsO_4 (1.6), $N_4(CH_2)_4$ (1.6), $NH_4H_2PO_4$ (1.5), $LiNbO_3$ (2.3), $BaTiO_3$ (2.4), and $SrTiO_3$ (2.4).

(3) Transparent thin-film layer having a lower refractive index than the hologram (or optical diffraction grating) layer: Specific examples of materials usable for constituting the transparent thin-film layer include LiF (1.4), MgF (1.4), $3NaF/AlF_3$ (1.4), AlF_3 (1.4), GaF_2 (1.3), and NaF (1.3).

(4) Reflective thin-film layer, of a metal, having a thickness of not more than 200 Å: The reflective thin film of a metal has a complex index of refraction, and the complex index of refraction, n^*, is represented by $n^* = n - iK$, where n represents the refractive index and K represents the absorption coefficient. Specifically, the following materials (n and K being given in parentheses) may be used for constituting the reflective thin-film layer of a

metal: Be (n = 2.7, K = 0.9), Mg (n = 0.6, K = 6.1), Ca (n = 0.3, K = 8.1), Sr (n = 0.6, K = 3.2), Ra (n = 0.9, K = 1.7), La (n = 1.8, K = 1.9), Ce (n = 1.7, K = 1.4), Cr (n = 3.3, K = 1.3), Mn (n = 2.5, K = 1.3), Cu (n = 0.7, K = 2.4), Ag (n = 0.1, K = 3.3), Au (n = 0.3, K = 2.4), Al (n = 0.8, K = 5.3), Sb (n = 3.0, K = 5.3), and Ni (n = 1.8, K = 1.8). Other materials usable here include Sn, In, Te, Ti, Fe, Co, Zn, Ge, Pb, Cd, Bi, and Se. Further, oxides, nitrides or other compounds of the above listed metals may also be usable. The metals and oxides, nitrides and other compounds of the metals may be used alone or in combination of two or more.

[0052]

(5) Resins having a refractive index different from the hologram (or optical diffraction grating) layer: The refractive index of the resins of this type may be larger than or smaller than that of the hologram layer 36. Examples of such resins (the refractive index being given in parentheses) include: polytetrafluoroethylene (1.35), polychlorotrifluoroethylene (1.43), vinyl acetate resin (1.45 - 1.47), polyethylene (1.50 to 1.54), polypropylene (1.49), methyl methacrylate resin (1.49), nylon (1.53), polystyrene (1.60), polyvinylidene chloride (1.60 - 1.63), vinyl butyral resin (1.48), vinyl formal resin (1.50), polyvinyl chloride (1.52 - 1.55), and polyester resin (1.52-1.57). Besides the above resins, conventional synthetic resins are usable, and resins having a refractive index greatly different

from that of the hologram layer are preferred.

[0053]

(6) Laminates comprising suitable combinations of the above materials (1) to (5): The combination of the materials (1) to (5) may be any one, and the positional relationship between layers in the layer construction may be selected as desired. Among reflective thin-film layers 37 formed of the above materials (1) to (6), the thickness of the reflective thin-film layer formed of the material (4) is not more than 200 Å. On the other hand, when the reflective thin-film layer is formed of any one of the materials (1) to (3), (5), and (6), the thickness may be such that the transparency is ensured. In this case, however, in general, it is preferably 10 to 10000 Å, more preferably 100 to 5000 Å. Regarding the formation of the transparent reflective thin-film layer 37 on the hologram (or optical diffraction grating) layer 36, when the reflective thin-film layer 37 is formed of any one of the materials (1) to (4), it may be formed by conventional thin-film forming means, such as vacuum deposition, sputtering, reactive sputtering, ion plating, and electroplating. On the other hand, when the reflective thin-film layer 37 is formed of the material (5), it may be formed by a conventional coating method. When the reactive thin-film layer 37 is formed of the material (6) (laminate), it may be formed by a suitable combination of the above means and method. When the material (5) is used, it should be noted that the layer may not be thin so far as the material

is transparent. In this case, according to another embodiment of the invention, a resin layer having a larger thickness than the thickness of the thin film may be provided in the hologram (or optical diffraction grating) layer 36.

[0054]

As described above, the formation of the ID card 1 of the present invention, using the transparent hologram or transparent optical diffraction grating thermal transfer sheet 3 having the hologram layer thus obtained, may be performed by providing sublimation type thermal transfer information and melt type thermal transfer information of a sublimable dye ink on a card substrate by means of a thermal head, providing a transparent protective layer 14 thereon, putting the thermal transfer sheet 3 having the hologram layer on the protective layer 14 so as for the surface of the heat sealer layer 38 to be brought into contact with the surface of the protective layer, and recording the information by means of the thermal head, thus obtaining an ID card with a patterned hologram (or optical diffraction grating) layer.

[0055]

FIG. 8 is a sectional view showing an embodiment of the hot-bondable hologram thermal transfer label. A laminate including a hologram layer may be generally prepared by providing a transparent film as a substrate, optionally providing a primer layer 34 on one surface of the transparent film, and laminating

thereon a hologram (or optical diffraction grating) layer 36, a transparent reflective thin-film layer 37, and an adhesive layer 39 in that order. In FIG. 8, the transparent substrate film 31 may be the same plastic film as described above in connection with the substrate film 21 shown in FIG. 6 so far as the film is transparent. The thickness of the transparent film 31 may be 3.5 to 300 μm. However, it should be noted that, for the thickness of the substrate film 31, when a hot stamper (a hot plate) or a hot roll is used as the transfer means, the substrate film is preferably somewhat rigid. For example, when a biaxially stretched polyethylene terephthalate film is used as the substrate film, the thickness thereof is preferably about 12 to 50 μm. The primer layer 34 may be optionally provided depending upon the type of the transparent substrate film 31. It may be formed, for example, by coating a properly selected conventional primer resin composed mainly of a urethane resin, a vinyl chloride/vinyl acetate copolymer resin, an acrylic resin or the like.

[0056]

When the transparent substrate film 31 is a biaxially stretched PET film, a good primer layer can be formed by coating a coating liquid comprising a urethane resin with an isocyanate incorporated thereinto. The hologram (or optical diffraction grating) layer 36 and the transparent reflective thin-film layer 37 as described above in connection with the thermal transfer

sheet for hologram shown in FIG. 7 as such may be applied to this embodiment. The adhesive layer 39 used may be the same as the heat sealer layer 38.

[0057]

As described above, the formation of the ID card 1 of the present invention, using the transparent hologram or transparent optical diffraction grating thermal transfer label 4 having the hologram layer thus obtained, may be performed by providing sublimation type thermal transfer information and melt type thermal transfer information of a sublimable dye ink on a card substrate by means of a thermal head, providing a transparent protective layer 14 thereon, putting the thermal transfer label 4 having the hologram layer on the protective layer 14 so as for the surface of the adhesive layer 39 to be brought into contact with the surface of the protective layer, and applying heat and pressure to the laminate by means of a hot plate or a hot roll to heat bond the laminate to the protective layer, thus obtaining an ID card with a patterned hologram (or optical diffraction grating) layer.

[0058]

[Example 1]

<ID card substrate> As the card substrate, a 0.56 mm thick card substrate comprising 100 parts of a polyvinyl chloride (polymerization degree: 800) compound containing about 10% by weight of an additive such as stabilizer, 10 parts of a white

pigment (titanium oxide) and 0.5 parts of a plasticizer (DOP) was prepared. This card substrate was used after cutting into individual cards (each measuring 54.0 mm long and 85.6 mm wide). Using a thermal transfer sheet 2 prepared under the following conditions, personal attribute information was recording on this ID card substrate.

[0059] <Formation of sublimation type thermal transfer information, melt type thermal transfer information and transparent protective film> Sublimation type thermal transfer information, melt type thermal transfer information and a transparent protective film are formed on the ID card substrate using a printer of an ID card issue system.

① Ink sheet for sublimation type thermal transfer

Using a 6 μm thick continuous film of polyethylene terephthalate (hereinafter referred to as "PET film") (Lumirror, manufactured by Toray Industries, Inc.) as a substrate film, a coating liquid, for a heat-resistant slip layer, having the following composition was coated on one surface of the substrate film by gravure coating using a full solid plate at a coverage of 1.0 g/m^2 on a dry basis, and the coating was dried to form a heat-resistant slip layer which was then heated in an oven at 60°C for 5 days to cure the heat-resistant slip layer.

Composition of coating liquid for heat-resistant slip layer

Polyvinyl butyral (S-lec BX-1, manufactured by Sekisui Chemical Co., Ltd.)	3.6 parts

Polyisocyanate (Burnock D750, manufactured by Dainippon Ink and Chemicals, Inc.)	8.4 parts
Phosphate surfactant (Plysurf A208S, manufactured by Dai-Ichi Kogyo Seiyaku Co., Ltd.)	2.8 parts
Talc (Microace P-3, manufactured by Nippon Talc Co., Ltd.)	0.6 parts
Toluene/methyl ethyl ketone (weight ratio = 1:1)	190 parts

[0060]

Sublimable dye inks of three colors, i.e., a sublimable yellow dye ink, a sublimable magenta dye ink, and a sublimable cyan dye ink having the following respective compositions were printed on the surface of the substrate film remote from the beat-resistant slip layer were coated by gravure printing to form sets of coatings, each set consisting of three colors of yellow, magenta, and cyan with each color coating having a size of 10 cm in length and 14 cm in width, each at a coverage on a dry basis of 1.3 g/m^2 in a face serial manner in the longer direction of the substrate film and in a plurality of rows in the shorter direction of the substrate film, thereby forming a sublimable dye ink layer. In this case, the sets of coatings were provided while leaving a space of 16 cm between each two sets in order to provide a hot-melt ink layer (black).

Composition of sublimable yellow ink

Dye (FORON BRILLIANT YELLOW S-6GL)	5.5 parts
Polyvinyl acetoacetal (KS-5, manufactured by Sekisui Chemical Co., Ltd.)	4.5 parts
Polyethylene wax	0.1 parts
Toluene/methyl ethyl ketone (weight ratio = 1:1)	89.0 parts

Composition of sublimable magenta ink

The composition of the sublimable magenta ink was the same as that of the sublimable yellow ink, except that only the dye was replaced with a magenta dye (consisting of 1.5 parts of MS RED-G and 2.0 parts of MACROLEX RED VIOLENT R).

Composition of sublimable cyan ink

The composition of the sublimable cyan irk was the same as that of the sublimable yellow ink, except that only the dye was replaced with a cyan dye (Kayaset Blue 714).

[0061]

② Subsequently, in order to provide a hot-melt black ink layer in each space (a size of 10 cm in length and 16 cm in width) provided at intervals of 16 cm between the above sets of sublimable dye ink layers, a coating liquid, for a release layer, having the following composition was first coated by means of a gravure coater at a coverage on a dry basis of 1.0 g/m^2, and the coating was dried to form a release layer.

Composition of coating liquid for release layer

Urethane resin (Hydran AP-40, manufactured by Dainippon Ink and Chemicals, Inc.)	70 parts
Polyvinyl alcohol (Gosenol C-500, manufactured by Nippon Synthetic Chemical Industry Co., Ltd.)	30 parts
Fluorescent brightening agent (Uvitex C.F., manufactured by Ciba-Geigy)	0.5 parts
Water/ethyl alcohol (weight ratio = 2:1)	300 parts

Further, in order to provide a release protective layer and a hot-melt ink layer (black) each having the same size as the release layer, a coating liquid, for a release protective layer, having the following composition and an ink, for a hot-melt ink layer, having the following composition were coated on the release layer by gravure coating each at a coverage on a dry basis of 1.0 g/m^2, and, for each coating, dried to form a hot-melt ink layer region.

[0062]

Composition of coating liquid for release protective layer

Acrylic resin (BR-85, manufactured by Mitsubishi Rayon Co., Ltd.)	88 parts
Polyethylene wax	11.5 parts
Polyester	0.5 parts
Fluorescent brightening agent (Uvitex O.B., manufactured by Ciba-Geigy)	0.5 part
Toluene/methyl ethyl ketone (weight ratio = 1:1)	300 parts

Composition of coating liquid for release protective layer

Vinyl chloride-vinyl acetate copolymer resin	60 parts
Carbon black	40 parts
Toluene/methyl ethyl ketone (weight ratio = 1:1)	200 parts

[0063]

③ Preparation of thermal transfer sheet for formation of protective layer

Using a 6 μm thick PET film (Lumirror, manufactured by

Toray Industries, Inc.) as a substrate film, and a coating liquid, for a heat-resistant slip layer, having the same composition as described above in connection with the preparation of a thermal transfer sheet for the formation of an image was coated on one surface of the substrate film by gravure coating using a full solid plate at a coverage of 1 g/m^2 on a dry basis, and the coating was dried and cured in the same manner as described above to provide a heat-resistant slip layer. A coating liquid, for a release layer, having the same composition as described above in connection with the provision of the hot-melt ink layer was coated by gravure coating on the whole surface of the substrate film remote from the heat-resistant slip layer at a coverage of 1 g/m^2 on a dry basis, and the coating was dried to provide a release layer. Thereafter, a coating liquid, for a release transparent resin layer, having the following composition was coated by gravure coating on the release layer at a coverage of 1.5 g/m^2 on a dry basis, and a coating liquid, for an adhesive layer, having the following composition was coated thereon at a coverage of 1 g/m^2 on a dry basis to provide a release transparent resin layer and an adhesive layer, thereby preparing a transfer film for a protective layer.

[0064]

Composition of coating liquid for release transparent resin layer

Acrylic resin (BR-83, manufactured by Mitsubishi Rayon Co., Ltd.)	95 parts
Polyethylene wax	5 parts

Polyester	0.5 parts
Toluene/methyl ethyl ketone (weight ratio = 1:1)	300 parts

Composition of coating liquid for adhesive layer

Urethane resin	20 parts
Toluene/methyl ethyl ketone (weight ratio = 1:1)	80 parts

[0065] <Recording of photograph of face and character information> The photograph was recorded by putting a sublimable dye ink layer of a sublimation type thermal transfer sheet on an ID card substrate and by applying thermal energy by means of a thermal head. In the same manner, recording of the character information and transfer of a transparent protective layer were carried out by applying thermal energy by means of a thermal head at a hot-melt ink layer region 22 and a sheet for transparent protective layer.

[0066] ① Construction of transparent hologram (optical diffraction grating) layer

A transfer sheet for transparent hologram (optical diffraction grating) layer used in the present invention was formed by providing a release layer, a hologram layer, a reflective thin film layer and an adhesive layer on one surface of a 12 μm thick PET film substrate in this order, placing a resin, and heat-pressing an original plate for a hologram to form the unevenness of a relief hologram.

[0067] ② Preparation of thermal transfer sheet for hologram

Using a 25 μm thick PET film (Lumirror, manufactured by Toray Industries, Inc.) as a substrate film, a release protective layer, a hologram layer, a reflective thin-film layer (transparent), and an adhesive layer were formed on one surface of the substrate film by the conventional method to prepare a thermal transfer sheet for hologram. The reflective thin-film layer was formed in a thickness of 1000 Å by sputtering. Compositions of coating liquids and materials used for the formation of the above layers were as follows. The hologram layer was constructed as a relief hologram after the formation of a resin layer by coating.

Composition of coating liquid for release protective layer

Cellulose acetate resin	5 parts
Methyl alcohol	25 parts
Methyl ethyl ketone	45 parts
Toluene	25 parts
Melamine resin with methylol group introduced thereinto	0.5 parts
p-Toluenesulufonic acid	0.05 parts

[0068]

Composition of coating liquid for hologram layer

Acrylic resin	40 parts
Melamine resin	10 parts
Anone	50 parts
Methyl ethyl ketone	50 parts

Material of reflective thin layer (transparent): ZnS

Composition of coating liquid for adhesive layer

Vinyl chloride-vinyl acetate copolymer resin	20 parts
Acrylic resin	10 parts
Ethyl acetate	20 parts
Toluene	50 parts

[0069] ③ Preparation of print with hologram

A full-color photograph-like image of a face using sublimable dye inks was formed, using the thermal transfer sheet for the formation of an image, prepared in the above item, by means of a thermal transfer printer on the surface of the card substrate by applying thermal energy with a thermal head connected to electrical signals obtained by color separation of the photograph of a face, and characters and the like for an identification card were printed with the hot-melt black ink. Subsequently, a protective layer was transferred, using the thermal transfer sheet for the formation of a protective layer, prepared in the above item, onto the full-color photograph-like image of a face by applying thermal energy by means of the thermal head of the printer.

[0070] ④ Transfer of transparent hologram layer

The thermal transfer sheet for hologram, prepared in the

above item ② was put on top of the protective layer on the full-color photograph-like image of a face so that the adhesive layer of the thermal transfer sheet came into contact with the protective layer. Then, the first name "Yamada" was transferred in a pattern of characters in the transparent hologram layer onto the protective film of the ID card at the side of the substrate film of the thermal transfer sheet for hologram. Each character of the Chinese characters reading Yamada has a size of 25 mm squares.

[0071]

The ID card with a transparent hologram thus obtained in Example 1 was observed. As a result, the first name was formed on the ID card having personal attribute information recorded thereon in a pattern of characters and the transferred image could be viewed from a distance of 10 m. Also the personal attribute information recorded on the ID card could be clearly viewed by observing at different angles.

[0072]

[Example 2]

A print with a hologram of Example 2 was prepared in the same manner as in Example 1, except that, instead of the formation of the hologram layer, on the protective layer on the surface of the card, by thermal transfer, a hot-bondable laminate including a hologram layer was prepared as follows and heated and pressed by means of a hot plate having a shape of characters of "Yamada",

each character having a size of 25 mm squares, under conditions of 150°C and 1 kg/cm^2 to laminate the laminate onto the protective layer. For the print with a hologram prepared in this example, as with the print with a hologram prepared in Example 1, the transferred image could be viewed from a distance of 10 m. Also the personal attribute information recorded on the ID card could be clearly viewed by observing at different angles.

[0073] < Preparation of hot-bondable laminate including hologram layer>

A coating liquid, for a primer layer, having the following composition was coated by gravure coating on one surface of a 25 μm thick transparent PET film at a coverage of 1 g/m^2 on a dry basis, and the coating was then dried to form a primer layer. A hologram layer, a reflective thin-film layer, and an adhesive layer were laminated in this order on the primer layer in the same manner as described in Example 1 in connection with the thermal transfer sheet for a hologram to prepare a laminate including a hologram layer.

Composition of coating liquid for primer layer

Urethane resin	19 parts
Isocyanate	1 part
Toluene/methyl ethyl ketone (weight ratio = 1:1)	80 parts

[0074]

[Effect of the Invention]

The ID card has characters such as name printed thereon, although there is a limitation in the size of the characters to that of the card and makes it impractical to read the characters from a distance for identification. Since the ID card of the present invention has a pattern of characters such as first name formed thereon in a transparent hologram (or optical diffraction grating) layer while maintaining the function as the ID card, it ensures clear visibility of the name or the like. The present invention is also characterized in that the ID card is designed to show the name or the like being enlarged with the highest visibility when viewed squarely in front, in case the ID card is put on the chest of the card holder as a name plate, without preventing visibility of the ID information.

[BRIEF DESCRIPTION OF THE DRAWINGS]

FIG. 1 is a sectional view of the ID card according to an embodiment of the present invention.

FIG. 2 is a sectional view of the ID card according to another embodiment of the present invention.

FIG. 3 shows a case when the ID card is viewed in an angle out of the predetermined range of view angles.

FIG. 4 shows a case when the ID card is viewed within the predetermined range of view angles.

FIG. 5 shows the front view of the ID card.

FIG. 6 is a sectional view showing an embodiment of thermal

transfer sheet used in thermal transfer of information.

FIG. 7 is a sectional view showing an embodiment of the thermal transfer sheet for hologram used to transfer the hologram layer.

FIG. 8 is a sectional view showing an embodiment of the hologram thermal transfer label used to transfer the hologram layer.

[Explanation of letters or numerals]

1: ID card

2: thermal transfer sheet

3: transparent hologram or transparent optical diffraction grating thermal transfer sheet

4: transparent hologram or transparent optical diffraction grating thermal transfer label

11: card substrate

12: sublimation type thermal transfer information

13: melt type thermal transfer information

14: transparent protective film

15: transparent hologram label

15a: transparent hologram (or optical diffraction grating) layer

15b: transparent reflective thin film layer

15c: adhesive layer

15d: transparent label substrate

16: heat sealer layer

17: transparent protective film

18: hologram (or optical diffraction grating) information

21: substrate film

22: hot-melt ink layer region

22a: release layer

22b: release protective layer

22c: hot-melt ink layer

23: heat-resistant slip layer

28: sublimable dye ink layer

31: substrate film

32b: release protective layer

33: heat-resistant slip layer

34: primer layer

36: transparent hologram (or optical diffraction grating) layer

37: transparent reflective thin film layer

38: heat sealer layer

39: adhesive layer

[FIG. 1]

11: card substrate

12: sublimation type thermal transfer information

13: melt type thermal transfer information

14: transparent protective film

15a: transparent hologram (or optical diffraction grating) layer

15b: transparent reflective thin film layer

16: heat sealer layer

17: transparent protective film

[FIG. 2]

11: card substrate

12: sublimation type thermal transfer information

13: melt type thermal transfer information

15a: transparent hologram (or optical diffraction grating) layer

15b: transparent reflective thin film layer

15c: adhesive layer

15d: transparent label substrate

[FIG. 3]

1: ID card

12: sublimation type thermal transfer information

13: melt type thermal transfer information

[FIG. 4]

18: hologram (or optical diffraction grating) information

[FIG. 5]

(A) incident light, reflected light

(B) incident light, light is not reflected

[FIG. 6]

21: substrate film

22: hot-melt ink layer region

22a: release layer

22b: release protective layer

22c: hot-melt ink layer

28: sublimable dye ink layer

[FIG. 7]

31: substrate film

32b: release protective layer

36: transparent hologram (or optical diffraction grating) layer

37: transparent reflective thin film layer

38: heat sealer layer

[FIG. 8]

34: primer layer

39: adhesive layer

[Amendment]

[Submission Date] March 25, 1999

[Amendment 1]

[Name of Document for Amendment] Specification

[Name of Item for Amendment] 0014

[Means of Amendment] Alteration

[Contents of Amendment]

[0014] Wavelengths of visible light are from 400 nm to 700 nm. Thus in case the diffraction grating has a pitch of 550 nm, diffraction angles β are in a range from $-10°$ to $30°$ when incident angles α are from $45°$ to $80°$, while the light is hardly reflected with angle β in a range from $-45°$ to $0°$ when incident angles α are from $0°$ to $45°$. In order to further improve the visibility of the card used as a name plate when viewed from a distance, a diffraction grating that has higher diffraction efficiency may be used, such as blazed diffraction grating or volume hologram.